

PATENT SPECIFICATION

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DRAWINGS ATTACHED.



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COMPLETE SPECIFICATION.

Foam-Backed Carpets and Method for Their Production.

We, THE DOW CHEMICAL COMPANY, a Corporation organized and existing under the Laws of the State of Delaware, United States of America, of Midland, County of 5 Midland, State of Michigan, United States of America, do hereby declare the invention, for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement:—

This invention relates to carpets that have laminated to the back side thereof a resilient foam material and to a novel method for 10 their manufacture.

It has been proposed to produce foam-backed carpets by mechanically whipping a 15 foam material and then metering it onto the back of a carpet. The carpet then is passed into an oven whereby the foam is gelled or vulcanized to prevent collapse. Relatively long oven or curing times are required due to the insulating value of the foam itself. Another disadvantage of this prior art 20 method is that precise foam formulations and processing conditions are required to achieve the necessary rapid gelling of the foam after it enters the curing oven. If the foam collapses, the expensive carpet may be ruined. Before applying the foam to the 25 carpet the carpet back is usually sized with a latex to stabilize the carpet and, in the case of tufted carpets, to lock the tufts in place. Moreover, an anchor coating is generally required in addition to assure a sufficient bond between the foam and the carpet.

The present invention provides foam-backed carpets which comprise a foamed, 30 resilient, rubber-like material integrally laminated to the back side of a carpet web

wherein the adhesive means for holding the carpet web and the foamed rubber-like material in joined lamination is an intermediary layer which consists of or contains 45 a thermoplastic polymer of an olefin having from 2 to 4 carbon atoms.

The present invention further provides a method for producing foam-backed carpets of the invention, which comprises bringing together a web of foamed, resilient, rubber-like material and the back of a carpet web between nip rolls, providing molten thermoplastic olefin polymer between the webs before and during their joinder in the nip of the nip rolls, and subsequently cooling the 50 molten polymer.

The integral carpet-foam products of the invention have excellent stability as regards 55 resistance to changes in shape, which changes may tend to be brought about either from external physical stresses or from changes in such things as humidity conditions or the like. In addition, the carpets have excellent wear resistance through the ability of the structure to give under weight or pressure. Aesthetic soft under-foot characteristics are also inherent in the products. The carpet products have the further desirable attribute of having high resistance 60 to skidding.

Normally, the foam layer of the carpets of the invention is uniformly bonded to the carpet web. This desirably prevents bulging or wrinkling of the installed carpet which can occur if the layers separate. Furthermore, the permanent bond made possible by the invention can eliminate problems from shifting and misalignment between carpet and foam layer either while the carpet is on a roll or installed on a floor.

Of particular and significant importance

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is that the integral carpet products can be made of but three principal components, namely, the carpet essentials (i.e., pile plus base or tufting material), the olefin polymer layer, and the foam rubber like web. In other words, the olefin polymer layer can be made to serve the manifold functions of binding the pile yarns to the tufting fabric, of acting as a sizing or stiffening agent to provide dimensional stability, and serving as a bonding agent to hold the foam rubber like web effectively and efficiently to the carpet back.

As indicated heretofore, ordinarily a separate agent, such as a latex, is applied to hold the pile yarns to the carpet backing. However, this latex usually of itself does not provide satisfactory dimensional stability. Therefore, a scrim (wide mesh fabric of burlap, paper and the like) is often applied to the backing, frequently with the aid of an adhesive. Furthermore, as practiced in the art, the foam web is often applied by a rather slow and tedious procedure, frequently requiring an adhesive to satisfactorily bind the foamed material to the carpet back. These complicated techniques are conveniently obviated by practice of the present invention.

The present invention thus provides a means for preparing a foam-backed carpet with the least number of steps and with the utmost reliability, uniformity, and reproducibility. A salient advantage of the invention is the provision of means for simultaneously back-sizing a carpet and laminating a foam backing thereto, which can conveniently be effected almost instantaneously.

The invention is illustrated in the accompanying drawings, in which:—

Figure 1 is a perspective view of a carpet with an integral backing of foam;

Figure 2 illustrates the integral carpet-foam structure of Figure 1 in fragmentary cross-section;

Figure 3, in schematic and diagrammatic elevation, partly in cross-section, illustrates one means of preparing the integral carpet-foam structures of the invention; and

Figure 4, in schematic and diagrammatic elevation, partly in cross-section, illustrates another means of preparing the integral carpet-foam structures of the invention.

With initial reference to Figures 1 and 2, there are illustrated the composite carpet-foam products of the present invention, generally designated by the reference numeral 10. The term "carpet" as used herein is meant to include such materials that are generally referred to as rugs, runners, and strips that are sewn into carpets and related structures. The composite carpet structure 10 comprises any conventional carpet layer 11, over which there is deposited on the back side thereof an inter-

mediate olefin polymer layer 12 to and with which there is effectively and efficiently laminated or bonded a foamed rubber or rubber-like layer 13. The olefin polymer layer 12 is actually deposited on the tufting or base material 14 of the carpet member, as illustrated in Figure 2, as contrasted to the carpet pile or face 15. (When tufted carpets are involved, the base material 14 is usually referred to as tufting material and for convenience will be so referred to in the ensuing description.)

The greatest benefit is achieved in the practice of the invention when a tufted carpet web is employed. This is simply for reasons that the polymer layer 12 provides a binding medium to hold the tufts in place as well as performing other of the indicated beneficial functions. However, other carpet constructions are equally as well utilized in practice of the invention including woven carpets.

The textile material of the carpet is not critical and may be of any of those conventionally employed in carpets. For example, the tufting material is usually of a relatively light and loosely woven material through which the tufts are drawn or stitched. These can be burlap, hemp, cotton and synthetics such as nylon, or polyolefins, e.g. polypropylene. Similarly, the pile or face of the carpet may be of natural or synthetic yarn or filament such as wool, cotton, rayon, nylon, acrylic, or polypropylene.

Furthermore, the carpet may be subjected to other processing conditions, if desired, before being subjected to the laminating step of the invention. For example, the tufting material before having applied to it the olefin polymer layer, may be sized with such formulations as starch or latex or even a coating of a polyolefin. The latter of which may be the same as or a different polymer than the applied olefin polymer layer 12. However, expeditiously, the carpet is unsized and the olefin polymer layer 12 that is applied provides this sizing and/or tuft binding function.

In a preferred embodiment of the invention, non-aromatic hydrocarbon polyolefins that are prepared by polymerization of non-aromatic aliphatic olefin monomers are employed for the polymer resin layer 12. Principally, those mono-olefin aliphatic olefin monomers (including polymerizable mixtures thereof) that contain from 2 to 4 carbon atoms, such as ethylene, propylene or butylene, are utilized.

The polyethylene or other non-aromatic hydrocarbon polyolefin which is employed in the practice of the invention may be one of any normally solid and film-forming nature. For example, the polymers of ethylene which are employed may be those, or similar to those, which sometimes are

referred to as "polythenes". Or, if desired, the ethylene and other non-aromatic hydro-carbon olefin polymers employed may be essentially linear polymers, or polyolefin products similar to those materials. The essentially linear, macromolecular, high density polyethylenes which may be employed have been referred to as "ultra-thenes". They ordinarily have greater apparent molecular weights (as may be determined from such characteristics as their melt viscosities) than the "polythene" type polyethylenes which are usually in excess of at least about 20,000 and generally in excess of about 40,000; densities of about 0.94—0.96 grams per cubic centimeter; and melting points in the neighbourhood of 125—135° C. They are also ordinarily found to have a more crystalline nature than conventional polyethylenes and may contain less than 3.0 and even less than 0.3 methyl radicals per 100 methylene groups in the polymer molecule.

Also, copolymers of the aforesaid hydrocarbon olefin monomers with each other, e.g., ethylene-propylene copolymer, and with other ethylenically unsaturated monomers that are copolymerizable therewith may be employed in the practice of the invention. Thus, copolymers of ethylene, propylene and butylene with monomers such as e.g. ethyl acrylate, methyl acrylate, methyl methacrylate and vinyl acetate can be beneficially utilized for the inter-deposited polymer layer 12. When such copolymers are employed, the copolymer should contain at least about 50 weight percent of the hydrocarbon olefin monomer polymerized in the polymer molecule. Copolymers of ethylene with another aliphatic ethylenically unsaturated monomer can be employed with advantage when greater flexibility in the finished carpet is desired. Moreover, when employing such ethylene copolymers with a tufted carpet web a more efficient binding of the tufts can often be achieved.

The thickness of the olefin polymer layer 12 will usually depend on several factors including the particular polymer involved, the foam composition or structure, and the structure and condition of the carpet. However, for most purposes, a polymer layer of from about 1 to about 15 mils (0.025 to 0.375 mm.) is satisfactory. In instances where the carpet is already back-sized, a layer of about 2 to 4 mils (0.050 to 0.1 mm.) may be beneficial, but, when the resin layer is to serve the dual purpose of backsizing (binding the tufts) and laminating the foam web, a thickness of about 8 to 12 mils (0.2 to 0.3 mm.) is preferred.

The foamed rubber web 13 need not be of a conventional rubber although vulcanized foamed webs of natural or synthetic rubber

are advantageously employed for the purpose. Other foamed structures that are flexible and resilient may be profitably employed. For example, foamed webs formed from polyurethanes can be used, as well as foamed webs of polyethylene, vinyl chloride resins or other flexible and resilient foam structures. It is preferable that the width of the foam web be the same as the carpet web, but lesser or greater width are tolerable for desired effects.

The thickness of the foam web is not of particular criticality. It may be a web of thickness from about $\frac{1}{16}$ to 1 inch (1.5 to 25 mm.) or more depending on the particular end use or desired effect in mind. Ordinarily, a thickness of $\frac{1}{8}$ to $\frac{1}{2}$ inch (3 to 12.5 mm.) is preferred. Actually, the principal practical upper limitation in foam web thickness is determined by the difficulties encountered in handling carpets on rolls with excessively thick foam webs. Such rolls in addition to being unwieldy, tend to unwind of themselves unless precautions are taken to prevent it. Also, too thick a web will allow the carpet itself to "move" underfoot to the point of making walking on it difficult.

With reference to Figure 3, there is shown a carpet 11 moving from a source (not shown) indicated by the directional arrow with the base or tufting material 14 facing upward and the pile or face 15 facing downward. From the opposite side a foam rubber web is shown moving in the direction indicated by the directional arrow from a source not shown. A sheet or layer of a molten thermoplastic olefin polymer 12 is delivered from extruder 16 between carpet 11 and foam rubber web 13. It is preferable that the molten polymer be applied between the carpet and foam rubber at the point nearest their juncture as they pass through the nip of rolls 17, which rolls co-operate to urge the two layers together. However, it may at times be desirable to apply the molten polymer to one, or even both, the carpet or foam rubber at a point a short distance before the nip. The rolls 17 may both be of steel or some other suitable hard material, or one or both may be of a more resilient material such as hard rubber. The molten polymer 12 normally begins to solidify upon contact with the relatively cool web surfaces. It may be desired to cool rolls 17 to facilitate the cooling. Alternatively, forced air or the like may be directed at the integral carpet-foam structure 10 as it emerges from the nip of rolls 17. The composite laminate structure 10 is then passed around idler roll 18 and onto storage roll 19. Of course, instead of winding the product for storage it may be passed directly into other processing or subsequent manufacturing treatments.

The olefin polymer may be contained in

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- an extruder 16, of any conventional or desired construction, adapted to expel a falling sheetlike layer or curtain 20 of molten olefin polymer through a suitable die orifice 5 between the carpet backing 14 or carpet 11 and foam web 13 in the nip of rolls 17. It is generally advantageous to maintain the olefin polymer at a temperature sufficiently high to insure its remaining in a fused and molten condition after being passed from the die to fall through the air as a layer between the carpet and foam webs. Thus, for example when the olefin polymer is polyethylene, it is generally desirable for the extruded polymer to make contact with the webs while it is at a temperature of at least about 350—375° F. (177—190° C.). This generally requires the molten polymer in the extruded barrel, as it leaves the die lips, to be at a temperature of from 550 to 650° F. (22 to 343° C.).
- The ultimate apparent thickness of the polymer layer can be controlled somewhat by the pressure in the nip of rolls 17, that is, higher pressures will tend to force the polymer into the carpet web. This pressure should not be excessive, however, since undesirable crushing of the carpet pile, as well as urging the polymer through onto the face 25 of the carpet, may occur. Generally, a pressure of 50 to 350 pounds per lineal inch (8.9 to 62.5 kg./cm.) will provide adequate penetration of the polymer into the carpet for good tuft binding.
- The actual amount of polymer that is applied between the webs and the thickness of the polymer layer, can be controlled by regulating the relative rate of travel of the webs and the rate of polymer extrusion. 30 Thus, for example, for a given web speed, increasing the polymer extrusion rate will increase the amount of polymer applied, decreasing the extrusion rate will provide a corresponding decrease in the amount of polymer applied. In connection with this, it is desirable that the carpet and foam web be fed to the nip at the same lineal rate of speed.
- As indicated, the nip rolls 17 may be cooled to expedite cooling and solidifying of the freshly extruded polymer. However, this is not necessary, and, in fact, when the polymer resin is to act as a sizing and tuft binding agent, any such cooling may be better avoided in order to give the molten polymer more time to flow into the carpet backing before it is solidified. In this instance, it may even be desirable to heat rolls 17, but this is usually unnecessary.
- With reference to Figure 4, there is shown another means for providing the carpet-foam structures of the invention. In the method illustrated, an olefin polymer 30 in powder, pulverulent or similar diminutive size is distributed from a suitable distri-
- butor (not shown) upon the base or tufting material 14 of carpet web 11 as it moves in the direction indicated by the directional arrow. Carpet web 11 passes under infrared lamps 31 or other suitable heating means whereby powdered polymer 30 (which is advantageously uniformly distributed on the tufting material) is heated and caused to fuse into a molten polymer layer 32. While layer 32 is still in a hot and essentially molten condition it is passed into the nip of rolls 17 where it is combined with foamed web 13 that is entering the nip from the opposite side to form the composite laminate structure 10. The carpet-foam laminate is subsequently passed around idler roll 18 and onto storage roll 19.
- Beneficially powdered polymer 30 is sized from 20—100 mesh (U.S. Standard sieve series) (0.07 to 0.8 mm.). This facilitates more uniform distribution of the polymer on the carpet and a more uniform as well as easier fused polymer layer on the carpet.
- Generally, heating the polymer at about 350—400° F. (177—204° C.) for 30—50 seconds will provide a thoroughly fused polymer layer. The powdered polymer layer should be uniformly heated in order to assure uniformity in the resulting fused layer. Otherwise, only a slight bond or no bond at all may be formed between the foamed web and the carpet, and other detrimental results including poor tuft lock and dimensional stability may be created.
- It is also important that the molten polymer layer 32 not be allowed to solidify prior to its juncture with foam web 13. Profitably, the web containing the fused polymer is passed into the nip immediately after being fused. Or, if desired, heat can be continuously applied to the polymer layer right up to the nip. However, excessive and prolonged heating should be avoided, particularly when materials in the carpet might be adversely affected.
- Ordinarily, the pressure between the nip rolls and the subsequent handling of the laminate carpet-foam structure are in general accordance with the method as described in connection with Figure 3.
- In order to further illustrate the invention a 1 foot (30.5 cm.) wide web of a wool tufted, unsized carpet was continuously fed with the tufting material facing upwards from one side into the nip of a pair of nip rolls. From the opposite side a 1 foot (30.5 cm.) wide preformed web of a $\frac{3}{8}$ inch (9.5 mm.) polyurethane foam was continuously fed into the same nip so that the carpet and foam web were joined in the nip. An extrusion die was positioned above the nip so that molten polymer extruded from the die fell vertically into the nip at the point of joinder of the carpet and foam web. Both the carpet and the web were fed to the nip

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- at about 15 ft. (4.6 m.) per minute. Polyethylene of density about 0.918 (melt index about 5) was continuously extruded from the extruder at about 625° F. (329° C.) at a rate of about 45 pounds (20 kg.) per hour between the carpet and foam web in the nip. The pressure at the nip rolls was such to apply about 300 pounds per linear inch (53 kg./cm.) pressure to the joined structures.
- The integral laminate structure so-formed was then continuously passed beyond the nip rolls around an idler roll and subsequently onto a take-up-roll, during which time the polyethylene was allowed to solidify forming about a 10 mil (0.25 mm.) thick interlayer.
- The integral carpet structure had excellent appearance, feel and resiliency. The foam could not be separated from the carpet backing. Attempts to break the bond were futile in that the foam would rupture before it could be pulled from the carpet. Similarly, the carpet tufts were uniformly and firmly bound in place. The foam-backed carpet exhibited excellent dimensional stability as well.
- Similar excellent results to the foregoing were obtained when other olefin polymers were employed including polyethylene of density of about 0.915 (melt index about 28), and a copolymer of about 88 per cent ethylene and 12 per cent ethyl acrylate, and when other foam webs were employed including a vulcanized styrene-butadiene foam web.
- WHAT WE CLAIM IS:—**
1. Foam-backed carpets which comprise a foamed resilient, rubber-like material integrally laminated to the back side of a carpet web, characterized in that the adhesive means for holding the carpet web and the foamed rubber-like material in joined lamination is an intermediary layer which consists of or contains a thermoplastic polymer of an olefin having from 2 to 4 carbon atoms.
 2. Carpets in accordance with Claim 1, characterized in that the polymer is polyethylene.
 3. Carpets in accordance with Claim 1, characterized in that the polymer is a copolymer of ethylene with another aliphatic ethylenically unsaturated monomer which is copolymerizable with ethylene.
 4. Carpets in accordance with Claim 3, characterized in that the copolymer contains at least 50 per cent by weight of polymerized ethylene and up to 50 per cent by weight of another copolymerized aliphatic ethylenically unsaturated monomer.
5. Carpets in accordance with any of Claims 1 to 4, characterized in that the foamed, resilient, rubber-like material is a polyurethane foam or a foamed natural or synthetic rubber.
6. Carpets in accordance with any of Claims 1 to 5, characterized in that the carpet web is tufted carpet web.
7. Method for producing the carpets as claimed in Claims 1 to 6, which comprises bringing together a web of foamed, resilient, rubber-like material and the back of a carpet web between nip rolls, providing molten thermoplastic olefin polymer between the webs before and during their joinder in the nip of the nip rolls, and subsequently cooling the molten olefin polymer.
8. Method in accordance with Claim 7, characterized in that the molten polymer is provided by extruding molten polymer between the webs prior to or at their point of joinder in the nip.
9. Method in accordance with Claim 7, characterized in that the molten polymer is provided by applying the polymer in solid, pulverulent form to the side to be joined of the carpet web and/or the foamed web and subsequently melting the polymer before the webs are joined in the nip.
10. Method for producing foam-backed carpets which comprises bringing together a web of foamed, resilient, rubber-like material and the back of a carpet web between nip rolls, providing molten thermoplastic olefin polymer between the webs before and during their joinder in the nip of the nip rolls, and subsequently cooling the molten olefin polymer substantially as described hereinbefore.
11. Method for producing foam-backed carpets, substantially as described hereinbefore with reference to the accompanying drawings.
12. Foam-backed carpets whenever produced by the method as claimed in any of Claims 7 to 11.
13. Carpets comprising a foamed, resilient, rubber-like material integrally laminated to the back side of a carpet web by adhesive means which consists of or contain a thermoplastic olefin polymer, substantially as described hereinbefore.
14. Foam-backed carpets substantially as described hereinbefore with reference to the accompanying drawings.

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